(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 396 429 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 90304907.0

(22) Date of filing: 04.05.90

(51) Int. Cl.5: C08G 18/34, C08G 18/48, C08G 18/61, C08G 77/452, C08G 18/83, A61L 17/00, A61F 2/00, A61L 15/64, A61K 9/00

(30) Priority: 04.05.89 IL 90193

(43) Date of publication of application: 07.11.90 Bulletin 90/45

(84) Designated Contracting States: AT BE CH DE DK ES FR GB GR IT LI LU NL SE

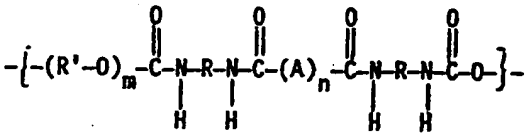
(71) Applicant: YISSUM RESEARCH DEVELOPMENT COMPANY OF THE HEBREW UNIVERSITY OF JERUSALEM
46 Jabotinsky Street.
Jerusalem, 92 182(IL)

(72) Inventor: Cohn, Daniel
32/6 Efrata Street
Jerusalem(IL)
Inventor: Yitzchaiek, Shlomo
89 Jabotinsky Street
Ramat Gan, 52553(IL)
Inventor: Bilenkis, Sophie
18 Hamagid Street
Jerusalem(IL)

(74) Representative: Ablewhite, Alan James et al
MARKS & CLERK 57/60 Lincoln's Inn Fields
London WC2A 3LS(GB)

(54) **Polyurethane-based polymeric materials and biomedical articles and pharmaceutical compositions utilizing the same.**

(57) The invention provides a polyurethane amide segmented copolymer selected from:
a) a segmented block polyurethane amide (PEUAm) of the following repeating unit [I]



wherein R is hexamethylene, 4,4′-diphenylmethane, toluene, naphthalene, 4,4′-dicyclohexylmethane, cyclohexyl, 3,3′-dimethylphenyl, 3,3′-dimethyl-diphenylmethane, 4,6′-xylylene, 3,5,5-trimethylcyclohexyl, 2,2,4-trimethyl-hexamethylene or p-phenylene,
R′ is selected from a linear or branched, unsubstituted or substituted hydrocarbyl group. the substituents being selected from halogen or hydroxy, or
R′ is a bivalent Si-(R_1R_2) group, wherein R_1 and R_2 are identical or different groups selected from hydrogen, alkyl, a double bond-containing hydrocarbyl group, halogen, hydroxy or an aromatic ring-containing group, and
m is a positive integer,
A is a bivalent saturated or unsaturated, linear or branched, substituted or unsubstituted hydrocarbyl group, the substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups; or
A is an unsubstituted or substituted aromatic ring-containing group, the substituents being selected from

EP 0 396 429 A2

POLYURETHANE-BASED POLYMERIC MATERIALS AND BIOMEDICAL ARTICLES AND PHARMACEUTICAL COMPOSITIONS UTILIZING THE SAME

The present invention relates to new and useful polyurethane-based polymeric materials, derived from reacting flexible diol chains with diisocyanates, and chain extending the obtained intermediate with carboxylic acid-capped molecules, to methods for the preparation of such polymeric materials and products such as biomedical articles derived therefrom.

There is a wide variety of materials which are foreign to the human body and which are used in direct contact with its organs, tissues and fluids. These materials are called Biomaterials. With the development of synthetic polymers, approximately one hundred years ago, physicians found available, for the first time, materials which were light, strong, relatively inert and easily fabricated, for use in a wide range of biomedical applications.

The concept of Biocompatibility relates to the quality of the biological performance of biomaterials. In addition to macroscopic function parameters, the interactions developed between the implanted device and its biological environment, play a crucial role. It is now consensual among researchers in the Biomaterials field, that the term "biocompatibility" and "biological performance" have no real meaning, unless they are related to a specific application and a given physiological environment. A variety of implanted devices now exists addressing needs in such diverse areas as cardiovascular surgery, ophthalmology, dentistry, orthopedics and gynecology, each area posing its own particular biocompatibility requirements.

Since materials are not universally biocompatible, the quality of their biological performance will depend on the implantation site and the specificity of the biological conditions under which they are called upon to perform. Nevertheless, and despite the impressive progress in Biomaterials Science, this more advanced conceptual development framework is seldom applied. Biomaterials are still being used, irrespective in most cases of the peculiarity and complexities of each clinical application. Furthermore, to date most polymeric biomaterials are substances that were initially developed by industry for general purposes and that found their way into the biomedical world.

Even though current Biomaterials have contributed significantly to modern medicine, only a new generation of devices, based on novel, tailor-made materials, will permit further progress. They should be developed on the premise that the different aspects of their intended performance - functional as well as biological - must be fully integrated into the design and synthesis processes. This should be achieved by incorporating, at a molecular level, features specifically selected for any given biomedical system.

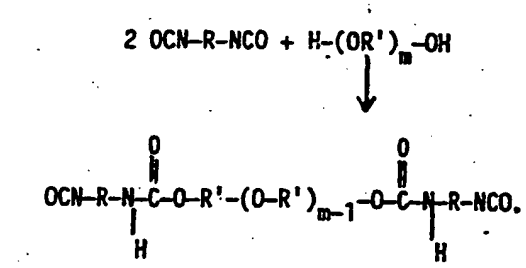
According to the present invention there is now provided a novel family of segmented polyurethanes by applying the approach outlined above.

Polyurethanes are one of the most promising and versatile biomedical polymers. These elastomeric block copolymers comprise, alternatively, hard and soft segments, and exhibit a phase segregated microstructure. The interest these materials have awakened stems mainly from their very good mechanical properties, especially tensile strength and flex fatigue (J.W. Boretos, Pure & Appl. Chem. 52, 1851 (1980); B.D. Ratner, in: Physicochemical Aspects of Polymer Surfaces (K.L. Mittal, Ed.), Plenum Publishing Corp., New York, 2, 969 (1983); M. Szycher and V.L. Poirier, Ind. Eng. Chemn. Prod. Dev. 22, 588 (1983)) and their enchanced biocompatibility (D.J. Lyman, D. Albo, R. Jackson and K. Knutson, Trans. Am. Soc. Int. Organs 23, 253 (1977); E.W. Merrill, E.W. Salzman, S. Wan, N. Mahmud, L. Kushner, J.N. Lindon and J. Currie, Trans. Am. Soc. Artif. Organs 28, 482 (1982); E. Nyilas, J. Biomed. Mater. Res. Symp. 3, 97 (1972); S.R. Hanson, L.A. Harker, B.D. Ratner and A.S. Hoffman, J. Lab. Clin. Med. 95, 189 (1980); J.W. Boretos, W.S. Pierce, R.E. Baier, A.F. Leroy and H.J. Donachy, J. Biomed. Mater. Res. 9, 327 (1975)).

These polymers have been considered for various applications such as the artificial heart, arterial prostheses, pacemaker leads, wound dressings and catheters (J.W. Boretos, Concise Guide to Biomedical Polymers, Thomas, Springfield, Illinois (1973)); J.W. Boretos and W.S. Pierce, Science 158, 1481 (1967); T. Kolff, G. Burkett and J. Feyen, Biomat. Med. Dev., Art. Org. 1(4), 669 (1973); E. Nyilas, U.S. Patent No. 3,562,352; P.J. Singh and D. Lederman, Implantable Left Heart Assist Device, Annual Report Contract No. NO1-HV-02913, NHLBI-DTB, Bethesda, Maryland (1982).

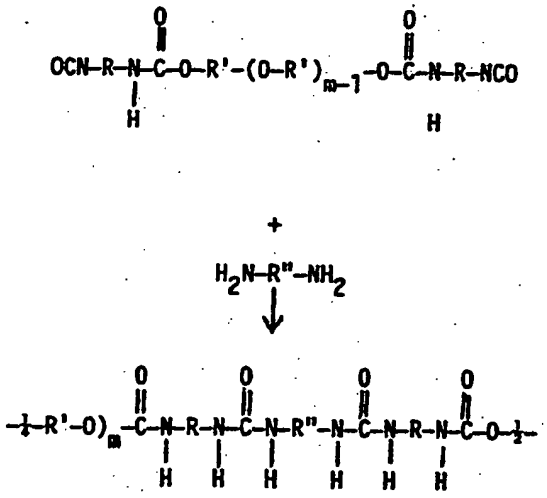
However, due to the rather demanding and diverse requirements biomedical polymers have to comply with, it has long been recognized that a need exists for new elastomeric polymers, exhibiting the advantageous properties of strength, flexibility and extensibility, and biocompatibility, as defined by any given, specific biomedical application. This can be illustrated by the fact that, even though polyurethane elastomers are known for their relatively satisfactory hemo-compatibility, when compared to other materials, post-implantation anticoagulant treatments (e.g. with heparin) are mandatory.

The chemistry involved in the synthesis of polyurethane elastomers centers around the reactions of the



The molecular weight of this oligomeric intermediate will vary within the 1000 to 5000 range, this being mainly determined by the length of the soft segment.

In the next stage the prepolymer is chain extended by reacting with diamines or diols, and producing the high molecular weight polyurethane chain. This second step is illustrated for diamines, in the following reaction:



Alternatively, the reaction can be performed in one step, but the properties of the polymer obtained are significantly inferior to those of the polyurethane synthesized step by step.

Thermoplastic elastomers are polymers characterized by rubber-like elasticity, even though they are not covalently crosslinked (L.R.G. Treloar, Rubber Chem. Technol 47(3), 625 (1974)). These macromolecules consist of glassy or crystalline hard blocks, dispersed in an amorphous matrix composed mainly by flexible soft segments. The unique feature of these polymers is that the macromolecular chains comprise two segments, which are chemically incompatible at service temperature. The positive heat of mixing characteristic of these segmented copolymers, is the driving force promoting phase separation processes. The fundamental mechanical function of the flexible segments is to provide the elastic response to the polymeric system. The hard blocks, on the other hand, create sites for secondary intermolecular bonding, forming generally well defined domains; from a mechanical point of view, the hard domains act as multifunctional physical crosslinks and reinforcing fillers.

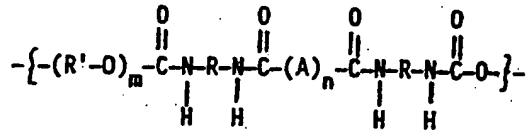
The two-phase microstructure, typical of most polyurethane elastomers, is accountable for their improved mechanical characteristics, most importantly, their high strength and enhanced flex-fatigue properties. The behavior of these matrices under mechanical stresses will be significantly influenced by the size, concentration and internal cohesive strength of the hard domains Additional factors are the ability of the segments to become oriented under external load and their crystallizability with strain (S.L. Agarwal, R.A. Livigni, L.F. Marker and T.J. Dudek, in Block and Graft Copolymers (J.J. Burke and V. Weiss, Eds.) Syracuse University Press, Syracuse, N.Y. 157 (1973); T.L. Smith, Polym. Sci. Phys., 12, 1825 (1974).

the preparation of such polymeric materials and products such as biomedical articles derived therefrom. Thus the present invention provides synthetic polymers having unique and desirable properties.

More specifically, the present invention provides polyurethane-based polymers from which can be manufactured biomedical articles such as sutures, ligatures, wound and burn dressings, membranes, catheters, oesophageal prostheses, vascular grafts, intra-aortic balloons, pacemaker leads, tracheal prostheses and intra-gastric balloons, possessing the desired characteristics of flexibility, strength, biocompatibility and sterilizability. Such is achieved, according to the invention, by reacting diverse hydroxy-ended flexible chains, most preferably poly(alkylene glycols) of various molecular weights, with different diisocyanates, and incorporating dicarboxylic acids as a new type of chain extender into the polymeric backbone, to produce segmented copolymers possessing increased flexibility and strength and exhibiting enhanced biocompatibility. The ability shown by the amide groups, produced by the reaction between the isocyanate and carboxylic functionalities, to form strong intermolecular hydrogen bonds, results in well developed hard domains and, in turn, in polymeric materials displaying improved mechanical properties. The enhanced stiffness and planarity associated with the amide group, due to its resonance structures and the consequent partial double bond nature of the C-N linkage is an additional advantageous feature of the chain extenders now provided. A number of polyurethene backbones were developed, most importantly chain extended by maleic or fumaric acid. This significantly affects the morphology, of the matrix, resulting in enhanced micro-phase segregation and improved mechanical properties. The new polyurethane-based, double bond-containing polymers will be referred to hereinafter as polyurethenes. The presence of the stiff and planar double bond structure, creating a conjugated system with the amide groups, substantially contributes to the crystallizability of the hard blocks. In addition to their effect on the mechanical properties of the polymeric matrix, the reactive double bonds can serve as binding sites for further derivatization of the polymer. Therefore, the polyurethene chains can serve as the basic scaffold for more complex polymeric systems, incorporating molecules bearing biological relevance. Furthermore, since the material-tissue interface very much determines the overall performance of the biomedical device, the potential for specific surface-tailoring is an additional built-in feature of these novel materials, not available with the polyurethanes of the prior art. Thus, guided by biological criteria derived from their specific clinical use, these polymers were surface or bulk tailored to improve their overall performance and/or optimize their interaction with their biological environment.

Thus according to the present invention there are now provided polyurethane-amides selected from:

a) a segmented block polyurethane amide (PEUAm) of the following repeating unit [I]



wherein R is hexamethylene, 4,4′-diphenylmethane, toluene, naphthalene, 4,4′-dicyclohexylmethane, cyclohexyl, 3,3′-dimethylphenyl, 3,3′-dimethyl-diphenylmethane, 4,6′-xylylene, 3,5,5-trimethylcyclohexyl, 2,2,4-trimethyl-hexamethylene or p-phenylene,

R′ is selected from a linear or branched, unsubstituted or substituted hydrocarbyl group, said substituents being selected from halogen or hydroxy, or

R′ is a bivalent Si-(R_1R_2) group, wherein R_1 and R_2 are identical or different groups selected from hydrogen, alkyl, a double bond-containing hydrocarbyl group, halogen, hydroxy or an aromatic ring-containing group, and

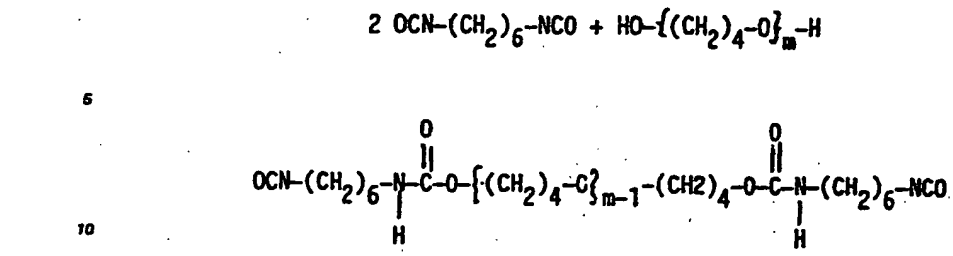
m is a positive integer,

A is a bivalent saturated or unsaturated, linear or branched, substituted or unsubstituted hydrocarbyl group, said substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups; or

A is an unsubstituted or substituted aromatic ring-containing group, said substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups, and

n is zero or a positive integer;

b) a segmented block polyurethane amide of the following repeating unit [II]

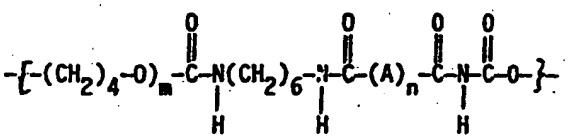


wherein m is a positive integer.

Additional diisocyanates used are 4,4′-diphenylmethane, toluene, naphtalene, 4,4′-dicyclohexylmethane, cyclohexyl, 3,3′-dimethylphenyl, 3,3′-dimethyl-diphenylmethane, 4,6′-xylylene, 3,5,5-trimethylcyclohexyl, 2,24-trimethyl-hexamethylene and p-phenylene, or other short molecules capped by two diisocyanate compounds of the above formula. Additional dihydroxy compounds that can be used include various poly-(alkylene glycol) chains such as polyethylene glycol and polypropylene glycol of different molecular weights, and also ethylene glycol; 1,3-propanediol; 1,4-butanediol; 1,5-pentanediol; 1,6-hexanediol; 1,7-heptanediol; 1,8-octanediol; 1,9-nonanediol; 1,10-decanediol; 1,11-undecanediol; 1,12-dodecanediol; 1,13-tridecanediol; 1,14-tetradecanediol; 1,15-pentadecanediol; 1,16-hexadecanediol; oxaaliphatic diols, diaminediol, hydroxy-terminated polydimethyl siloxane polymers and copolymers, fluorinated polyether glycols and poly(butadiene, hydroxyl terminated).

The reaction is carried out in dry solvents such as tetrahydrofuran or dimethylformamide.

In the next stage, the polymers of this invention are obtained by chain extending the prepolymer by reacting the isocyanate groups of the isocyanate-terminated triblock with a compound selected from a group consisting of carboxylic acid-capped chain extenders. Thus e. g. the invention provides copolymeric chains, as exemplified for HDI and PTMO, of the following repeating unit:



where the isocyanate-terminated triblock copolymers has been chain extended by compounds of the general formula,

$HOOC-(A)_n-COOH$

as previously defined.

Dicarboxylic acid compounds useful in the synthesis of polymers by the above method include oxalic acid; malonic acid; succinic acid; 2,3-dimethylsuccinic acid; glutaric acid; 3,3-dimethylglutaric acid; adipic acid; 3-methyladipic acid; pimelic acid; suberic acid; azelaic acid; sebacic acid; 1,9-nonanedicarboxylic acid; 1,10-decanedicarboxylic acid; 1,11-undecanedicarboxylic acid; 1,12-dodecanedicarboxylic acid; 1,13-tridecanedicarboxylic acid; 1,14-tetradecanedicarboxylic acid; 1,15-pentadecanedicarboxylic acid; 1,16-hexadecanedicarboxylic acid; maleic acid; trans-beta-hydromuconic acid; fumaric acid; diglycolic acid; 3,3′-oxydipropionic acid; 4,4′-oxydibutiric acid; 5,5′-oxydivaleric acid; 6,6-oxydicaproic acid; 8,8′-oxydicaprilic acid; 6-oxaundecanoic acid; 5-oxaazelaic acid; 5-oxasebacic acid; 5-oxaundecanoic acid; 5-oxadodecanoic acid; 5,oxatetradecanenoic acid; 5-oxahexadecanoic acid; 6-oxadodecanedioic acid; 6-oxatridecanedioic acid; 6-oxapentadecanedioic acid; 6-oxaheptadecanedioic acid; 7-oxapentadecanedioic acid; 10-oxanonadecanedioic acid and other oxa-aliphatic dicarboxylic acids; phtalic acid; isophtalic acid; terphthalic and other aromatic dicarboxylic acids; 1,2-cyclobutanedicarboxylic acid; 1,4-cyclohexanedicarboxylic acid; poly(butadiene, carboxyl terminated), poly(oxyalkylene, carboxyl terminated); carboxy-ended polydimethyl siloxane polymers and copolymers and halogen, hydroxy, amino or cyano-containing dicarboxylic acids.

Thus in a first aspect of the present invention there is now provided biomedical articles comprised of: a segmented block polyurethane amide (PEUAm) of the following repeating unit [I]

methacrylate) chains, amino-terminated polyethylene oxide chains, hexadecane or octadecane chains, poly)amido-amine) chains or from biodegradable chains selected from polyglycolic acid, polyactic acid or polyethylene glycol/polylactic acid block copolymers.

In these preferred embodiments the grafted chains perform as spacers for binding biologically active molecules selected from enzymes, antibiotics and anti-thrombogenic agents, onto the surface and/or bulk of the polymeric system. Thus in preferred embodiments of the present invention X and Y are the same or different and each is a biodegradably polyglycolic acid, polylactic acid or polyethylene glycol/polylactic acid block copolymer, temporarily bound to a biologically active molecule selected from an enzyme, antibiotic, hormone, or anti-thrombogenic agent whereby the system performs as a controlled delivery system.

The polyurethanes of formula [II] comprise unsaturated chain extenders of the general formula [III]

$$HOOC-(B)_a-CH=CH-(D)_bCOOH \quad III$$

wherein B and D are each an unsubstituted or substituted aromatic ring-containing group, said substituents being selected from halogen, cyano, carboxy or amino groups wherein B and D can be the same or different, and

a and b are identical or different and are each 0 or 1.

The molecules grafted onto the active double bond introduced into the polyurethene backbone via the incorporation of an unsaturated dicarboxylic acid, such as maleic acid or fumaric acid, differ substantially as a function of the specific clinical application of the polymeric system.

Various reactions were used to derivatize the basic polyurethene matrices. Preferred examples of these reactions are the following:

(1) grafting of active monomers onto the double bond, via a conventional addition polymerization mechanism, and (2) nucleophilic attack of appropriate agents (e.g. amines) on Michael-type substrates, such as the polyurethene olefinic double bond, which is conjugated with, and activated by electronegative unsaturated moities. The derivatization of the polymeric matrix can be exemplified by the grafting of 2-hydroxyethyl methacrylate (HEMA) for the first type of reaction, and by the addition of amino-terminated polyethylene oxide chains, for the second type of reaction. Clearly, these reactions may result, not only in grafting pendant groups onto the backbone, but also crosslinked matrices may be generated. Whether a thermoplastic or a thermoset system is obtained, will depend on the functionality, the molecular weight and the flexibility of the grafting molecule, as well as on several experimental parameters. Further examples of the derivatization of the system, useful in the invention may advantageously comprise, among others, epoxydation, hydroylation and halogenation reactions.

As indicated hereinbefore the polymers of the invention find advantageous utility in the manufacture of biomedical articles and pharmaceutical compositions as is known in the art of polymers in living systems. Thus, the present invention also provides biomedical articles including a suture or ligature, particularly in the form of flexible monofilaments, a suture in the form of a needle and a suture combination, a surgical clip or staple, a surgical prosthesis, a vascular graft, wound and burn coverings, membranes, catheters, oesophageal prostheses, intra-aortic baloons, pacemaker leads, tracheal prostheses and intra-gastric balloons, textile structures, couplings, tubes, supports, pins, screws or other forms of support. Yet further objects of this invention include a self-supporting film, hollow tube, beads or gel, containing a uniformly dispersed drug for controlled continuous administration, manufactured from polymers of the present invention.

The polymeric materials of this invention can be fabricated into films and fibers by melt extrusion. The polymers of the present invention are also useful in the manufacture of cast and/or extruded films and molded solid surgical aids and biomedical devices. The polymers are melt extruded through a spinneret in a conventional manner to for one or more filaments which are subsequently drawn about three to six times in order to achieve molecular orientation and improve tensile properties. The resulting oriented filaments have good tensile and dry knot strength and good in vivo strength retention. To further improve dimensional stability and tensile strength retention, the oriented filaments may be subjected to an annealing treatment, by heating them at various temperatures for different time periods, while preventing the filaments from measurable shrinking.

Fabrics comprising polymeric materials of this invention, alone or in combination with other polymers, have been developed by textile and non-textile techniques. Multicomponent fabrics, woven, knitted, felted, adhesively united or otherwise, comprising at least two different polymers, at least one of them according to the present invention, were prepared. Also fabric tubes having separate strands of bicomponent materials or strands of two separate components, wherein at least one is according to the invention, were produced. A coated fabric, comprising a substantially continuous sheet of a second material or materials was prepared by hot melt coating. A coating from a solvent system or with coating rolls; the base fabric of which may be wholly non-absorbable although it may contain an absorbable component, were produced.

Example 7: Preparation of PEUAm comprising HDI/PTMG2000/sebacic acid

The procedure of example 1 was followed using 1.01 gr (5 mmole) sebacic acid, to obtain the title compound.

Example 8: Preparation of PEUAm comprising HDI/PTMG2000/maleic acid

The procedure of example 1 was followed using 0.58 gr (5 mmole) maleic acid, to obtain the title compound.

Example 9: Preparation of poly(amido-amine)-grafted PEUAm comprising HDI/PTMG200/maleic acid

The procedure of example 1 was followed using 0.58 gr (5mmole) maleic acid, to obtain the basic polyurethene backbone. Then, 2 grams PEUAm were placed in a 125 ml flask fitted with a magnetic stirrer, together with 20 ml tetrahydrofuran (THF). The mixture was stirred for 24 hours, until the polymer was completely dissolved, and a clear and homogeneous solution was obtained. 1.6 mmole poly(amido-amine) and 10 ml methanol were added to the polymer solution, and the addition reaction was conducted, with continuous stirring, for 24 hours at room temperature. Next, the grafted polymer was casted on a glass plate, and the solvent was allowed to slowly evaporate at room temperature. Then, the polymeric film was repeatedly rinsed in water and finally dried at 50 °C under vacuum, until constant weight was obtained.

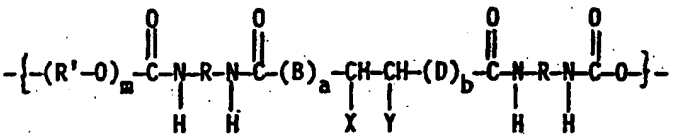
Some properties of the block copolymers produced according to the above examples, are set forth in Table I.

Example 10: Preparation of poly(amido-amine) surface grafted on PEUAm comprisng HDI/PTMG2000 maleic acid

The procedure of example 1 was followed using 0.58 gr (5 mmole) maleic acid, to obtain the basic polyurethene backbone. Samples (20 mm x 10 mm x 0.26 mm) were cut from films casted from 10% polymer solutions in THF, and immersed in a water-methanol (2:1), 0.3% weight solution of the poly(amido-amine). The reaction was conducted at 45 °C for 24 hours, when maximum addition to the double bond was attained. Then, the polymeric film was repeatedly rinsed in water and finally dried at 50 °C under vacuum, until constant weight was obtained.

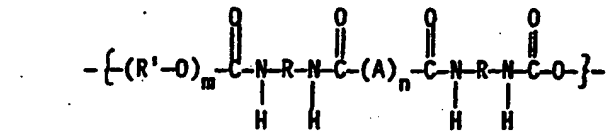
Example 11: Preparation of p(HEMA)-grafted PEUAm comprising HDI/PTMG2000/maleic acid

The procedure of example 1 was followed using 0.58 gr (5 mmole) maleic acid, to obtain the basic polyurethene backbone. Then, 2.45 grams PEUAm were placed in a flask together with 250 ml tetrahydrofuran (THF). The mixture was stirred for 24 hours, until the polymer was completely dissolved, and a clear and homogeneous solution was obtained. 1.6 mmole 2-hydroxyethyl methacrylate containing 1% weight bezoyl peroxide as the initiator of the free radical additional mechanism, were added to the polymer solution, and the reaction was conducted for 24 hours at 66 °C. Next, the grafted polymer was casted on a glass plate, and the solvent was allowed to slowly evaporate at room temperature. Then, the polymeric film was repeatedly rinsed in acetone and finally dried at 50 °C under vacuum, until constant weight was obtained.



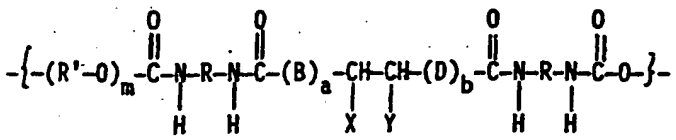
wherein R is hexamethylene, 4,4′-diphenylmethane, toluene, naphthalene, 4,4′-dicyclohexylmethane, cyclohexyl, 3,3′-dimethylphenyl, 3,3′-dimethyl-diphenylmethane, 4,6′-xylylene, 3,5,5-trimethylcyclohexyl, 2,2,4-trimethyl-hexamethylene or p-phenylene,
R′ is selected from a linear or branched, unsubstituted or substituted hydrocarbyl group, said substitutents being selected from halogen or hydroxy, or
R′ is a bivalent Si-(R_1R_2) group, wherein R_1 and R_2 are identical or different groups selected from hydrogen, alkyl, a double bond-containing hydrocarbyl group, halogen, hydroxy or an aromatic ring-containing group, and
m is a positive integer and
B and D are each a bivalent, saturated or unsaturated, linear or branched, unsubstituted or substituted hydrocarbyl group, said substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups, or
B and D are each an unsubstituted or substituted aromatic ring-containing group, said substituents being selected from halogen, cyano, carboxy or amino groups wherein B and D can be the same or different, and
a and b are identical or different and are each 0 or 1, and
X and Y are identical or different grafted substituents, usually bearing biomedical relevance.

2. A polyurethane amide segmented copolymer useful for the manufacture of biomedical articles, having a general repeating unit [I]



wherein R is hexamethylene, 4,4′-diphenylmethane, toluene, naphthalene, 4,4′-dicyclohexylmethane, cyclohexyl, 3,3′-dimethylphenyl, 3,3′-dimethyl-diphenylmethane, 4,6′-xylylene, 3,5,5-trimethylcyclohexyl, 2,2,4-trimethyl-hexamethylene or p-phenylene,
R′ is selected from a linear or branched, unsubstituted or substituted hydrocarbyl group, said substituents being selected from halogen or hydroxy, or
R′ is a bivalent Si-(R_1R_2) group, wherein R_1 and R_2 are identical or different groups selected from hydrogen, alkyl, a double bond-containing hydrocarbyl group, halogen, hydroxy or an aromatic ring-containing group, and
m is a positive integer,
A is a bivalent saturated or unsaturated, linear or branched, substituted or unsubstituted hydrocarbyl group, said substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups, or
A is an unsubstituted or substituted aromatic ring-containing group, said substituents being selected from halogen, hydroxy, cyano, carboxy or amino groups, and
n is zero or a positive integer.

3. A polyurethane amide segmented copolymer useful for the manufacture of biomedical articles, having a general repeating unit [II]
b) a segmented block polyurethane of the following repeating unit [II]



catheter, a vascular graft, oesophageal prosthesis, intra-aortic balloon, pacemaker lead, tracheal prosthesis, physical or biological support, screw or pin, where at least one of the components of each of said articles is a polymer as claimed in claim 1.

19. A compound vascular prosthesis comprising a polymer or polymers as claimed in claim 1.

20. A compound vascular prosthesis comprising a component selected from polyethylene terephthalate, polyether esters, polydimethyl siloxane polymers or copolymers, biodegradable polyether esters and a polymer or polymers as claimed in claim 1.

21. A selectively biodegradable vascular prosthesis comprising an absorbable component in the form of biodegradable polyether esters and a polymer or polymers as claimed in claim 1.

22. A selectively biodegradable vascular prosthesis manufactured by textile and non-textile techniques, comprising polymers as claimed in claim 1.

23. A wound or burn dressing comprising a polymer or polymers as claimed in claim 1.

24. A selectively biodegradable wound or burn dressing comprising an absorbable component selected from biodegradable polyether esters and a polymer or polymers as claimed in claim 1.

25. A pharmaceutical composition comprising a self-supporting film, hollow fiber, beads or gel, manufactured from a polyurethane amide segmented copolymer or copolymers as claimed in claim 1 and containing a uniformly dispersed drug contained therein.

26. A pharmaceutical composition comprising a self-supporting film, hollow fiber, beads or gel, manufactured from a polyurethane amide segmented copolymer or copolymers as claimed in claim 1(b) and a drug grafted to the polyurethene amide backbone via a spacer selected among biodegradable polymeric chains.